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(54) IMPROVEMENTS IN ARTIFICIAL RESPIRATORY DEVICES FOR PURPOSES SIMILAR TO THOSE FULFILLED BY DEVICES OF THE TYPE KNOWN AS "IRON LUNGS"

(71) I, ARTHUR PAUL PEDRICK, British subject, 77, Hillfield Road, Selsey, Sussex, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention is concerned with artificial breathing apparatus which, it is considered, might form an improvement on apparatus of the type known as the "iron lung".

The respiratory device known as the "iron lung", was developed mainly for use by vitims of polyiomylitis or what is known, more commonly, as "infantile paralysis", the Nuffield Trust being concerned particularly with the work, early models of the iron lung being constructed in works that now form part of the British Motor Corporation to the designs of Major Smith-Clark, M.B.E.

The use of the electron microscope subsequently enabled the poliomylitis virus to be isolated, and it was thus possible for the Salk Vaccine to be produced, which is now commonly administered to most children and forms an effective safe guard against the disease.

Unfortunately, the development of the Salk Vaccine has somewhat retarded incentive to improve further the design of "iron lung" devices, which is a pity, because there are still a considerable number of polio victims, who, having developed the disease before reaching the age of twenty, may have spent half their lives in such iron lungs, and will spend the rest of their lives in such machines, since there is no known cure for the disease once contracted.

For this reason the invention is concerned with improvements in the design of respiratory devices, which might improve the general comfort, and mobility, of persons who may otherwise spend the rest of their lives in so-called "iron lungs".

In the accompanying drawings

Figure 1 shows the main features of the "iron lung" form of artificial breathing apparatus, as it exists today.

Figures 2, 3 and 4 show how it is proposed to modify the apparatus, according to the invention, to incorporate distensible annular ring-like compressed-air-operated members in a close fitting "pullover jacket" or "jersey", to give an action which will generally apply the same effect to the lungs of a person, as occurs in an "iron lung".

Figure 5 shows how a person, wearing a garment, as described with reference to Figures 2, 3 and 4, might be accommodated in an adjustable chair, fitted with its own power unit, which will enable the polio patient to adjust its position and move about to a certain extent, without the help of other persons.

Figures 6 and 7, show a further development of the expandable jersey to incorporate a "vacuum reservoir" and handles at front and rear, for manual operation in an emergency.

Figures 8 and 9 show how a person provided with a jersey, as in Figures 6 and 7, may be accommodated in a chair which may be rocked manually, if there should be a failure of the power unit normally in operation.

Figure 10 shows a form of chair for a person wearing a distensible jacket, which is rocked by a motor and crank device normally, as well as manually, in an emergency, to apply the necessary vacuum to the exterior of a person's chest.

As shown in Figure 1, the "iron lung" is mainly a simple rectangular cross section box, within which the polio victim must lie, his, or her, head, projecting out of one end. The patient wears, round the neck, a form of rubber collar, which forms a crude type of airtight seal, that prevents vacuum conditions being lost within the iron lung.

Some form of air pump comprising a large bellows unit, driven by a suitable electric motor is coupled to the lung by a flexible

hose, and is effective to suck the air out of the lung at a regular beat, or period, appropriate to the rate at which a normal person breathes. There is thus produced a pressure differential between the atmospheric air in the chest of the patient, and that outside, which causes his, or her, real lungs to expand periodically.

It will be apparent that such apparatus renders a polio victim somewhat helpless, and dependent upon the services of other people. It is usual for the person in the iron lung to view things through a mirror *M* pivoted just above the head and for television viewing, radio manufacturers can arrange for the spot on the cathode ray tube to have its scan reversed so that lettering in a television broadcast, is seen correctly after one reflection in the mirror.

Ingenious devices are available whereby, by applying short or long puffs to a tube in the mouth, a polio victim, ("patient" is hardly the right word, since no cure is known) using a sort of Morse code, can operate a typewriter, and actuate various controls so as to answer a telephone and switch on, or shut off, a radio etc.

There are improved versions to the "iron lung", as shown schematically in Figure 1, a type known as the "Alligator" being capable of tilting, but it is clear such apparatus has an almost complete immobilising effect on the patient.

According to the invention, as shown in Figures 2, 3 and 4 it is proposed to apply a vacuum to the front of a person's chest, by incorporating, in a "pull-over" or close fitting jersey, or jacket, to be worn by the polio victim, a number of expandable annular rings, or tyre-like members, 5 so that application of periodical pulses of compressed air, to these expansible rings 5, will expand them and cause the fabric of the jersey, or jacket, to move away from the wearer's skin, thus leaving a space immediately surrounding the chest, which will be at sub-atmospheric pressure, against which the air within the person's real lungs, at atmospheric pressure, will be operative to expand his, or her, real lungs.

In order that the inside of the jacket shall be air-tight, close fitting air-tight seals of sponge, or foam, rubber, or similar material, are provided round the neck at 2, around the waist at 3, and above the wrists at 4.

The lead for compressed air is, preferably, connected to the expansible rings 5 from the rear of the jacket.

To obtain a still larger vacuum space in front of a person's chest, there might be one, or more, small bellows like units 5^1 as shown in Figure 4.

Figure 5 shows a possible form of adjustable chair in which the expandable jacket respirator might be used.

The patient lies on a mattress 6 supported on a base plate 7, 8 hinged at the centre, there being an end plate 9 to prevent the mattress 6 slipping downwardly.

The main hinge pivot, 10, is supported by an underframe on which is mounted an electric motor 11. The motor 11 drives an air compressor 12, which pumps air into a compressed air reservoir 13. The air reservoir has an outlet with a valve opened and shut, cyclically, by a mechanism 14, also driven by the motor 11, pulses of compressed air being thus, as required, transmitted through pipes 15, to the rings 5 on the expansible jacket worn by the patient.

The motor 11, preferably of a "rugged" type, such as a squirrel-cage motor, drives the rear wheels 17 of the chair through a transmission unit 16.

The motor 11 also operates, through transmission device 18, the pivoting of the steerable wheel 20, at the front of the chair.

Compressed-air-operated telescopic jacks, 21 and 22, at the rear and front of the base structure operate rams, to hinge up, or down, the parts 7 and 8 of the base plate of the mattress under the control of the patient. Preferably, he, or she, may control, also, through coded pulses on the mouth tube, the movement of the chair and its steering, by the rear and front wheels, respectively.

As shown in Figures 6 and 7, the respiratory jacket has a compressed air supply space 32, at the rear, into which air is pumped by delivery pipe 15, the air then being passed to the expandable rings 5.

There is also provided a bellows-like vacuum reservoir 33 to the rear of space 32, to which the suction side of the compressed air pump is connected by pipe 31, the vacuum reservoir being connected to the space directly in front of the patient's chest by the small clearance between the sides of the jacket and the skin of the wearer.

Thus such a jacket will at all times have a vacuum created round the skin of the wearer, within the jacket, but be expanded away, at the front, by the periodic pressurisation of annular rings 5.

In order that the jacket may be made effective if there is a failure of the compressed air supply, there are provided handles 34, at the front, and 35, at the rear, which may be used by a person, with the patient, to create the pumping action necessary to sustain the breathing of the patient.

In Figures 8 and 9, there is shown a form of couch able to be tilted about a pivot bearing 40, so that the jacket is stretched away from the patient's chest, on backward tilting of the couch, by the tension in a spring 41^1 between a fixed bracket 41^2 and the outer face of the jacket, the patient thus having his, or her, lungs expanded by the atmospheric air within [illegible] reduced

pressure created by the space within rings 5, during the backward pivoting of the couch about pivot 40.

When the couch is tilted forwards, as in Figure 9, the front of the jacket is compressed on to the patient's chest while the bellows unit 43, behind the couch, is expanded to reduce the pressure within the jacket. A handle 49 at the top of the couch may be used for manual pivoting of the couch in the event of a breakdown of the air supply pump.

As shown in Figure 8, the base frame of the couch has mounted in it the electric motor 44, which may be clutched to drive the rear wheels through a transmission unit 45. The other side of the motor, 44, drives the air pump 46, which delivers compressed air to air reservoir 47 by pipe 46'. The pump suction side is connected by suction pipe 31 to the bellows-like vacuum reservoir 43, and the compressed air is led from air reservoir 47 to the space 32 by delivery pipe 15, which has a valve opened and closed periodically by a cam driven by the air-pump drive-spindle, where it extends between the pump 46 and reservoir 47.

If the patient is not too badly paralysed, it may be possible for him, or her, to use a pedal 42 to steer the chair by the front wheels.

Figure 10 of the drawings shows a somewhat simpler arrangement in which the patient is seated in a form of rocking chair, having a main structure 51, which may be rocked about a pivot bearing 50. The front of the jacket is secured to the top of a bracket 52. Behind the chair is a bellows pump unit 55. An electric motor 59 operates a disc 57 and crank 56, to rock the chair about its pivot 50.

When the chair is rocked forwardly, the bellows unit 55 is expanded to draw air out of the space within the jacket, and the front of the jacket is forced back towards the skin of the chest of the patient.

When the chair is rocked back, the bellows unit 55 is compressed, forcing air into the annular expandable rings 5, which forces the jacket away from the patient's chest, creating the sub atmospheric pressure thereon necessary for expansion of atmospheric air in his, or her, lungs.

Manual rocking of the chair may be carried out using handle 54, and if patient is not paralysed in the legs, he, or she, might be able to self rock the chair by pressure on foot bracket 58.

WHAT I CLAIM IS:—

Respiratory apparatus for persons suffering from polyiomylitis, or similar illnesses, in the form of a jacket of airtight flexible material, having, incorporated in its structure, a plurality of annular expandable hollow rings of rubber, or like, elastomeric material, which, when supplied with compressed air, will cause the jacket to expand away from the wearer's chest, thus leaving, in front of it, a space at subatmospheric pressure, the atmospheric pressure in the wearer's lungs being, under these conditions, operable to expand the person's lungs, as a result of the subatmospheric pressure created within the jacket, characterised in that the jacket has incorporated in it airtight seals of sponge rubber, or similar material, around the neck, above the wearer's wrists, and around the waist.

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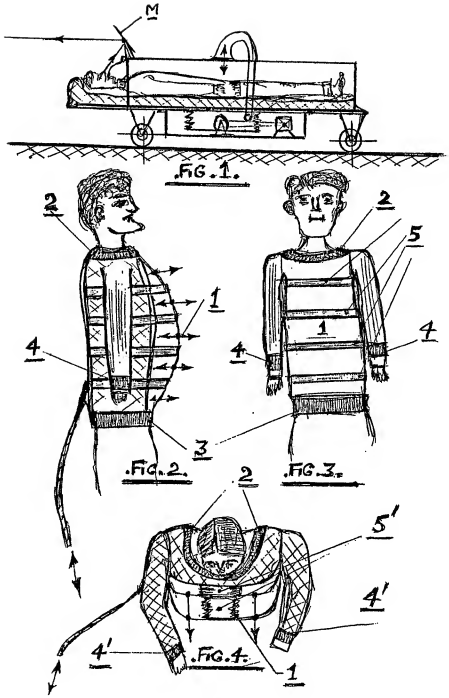
1205200 COMPLETE SPECIFICATION
4 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1



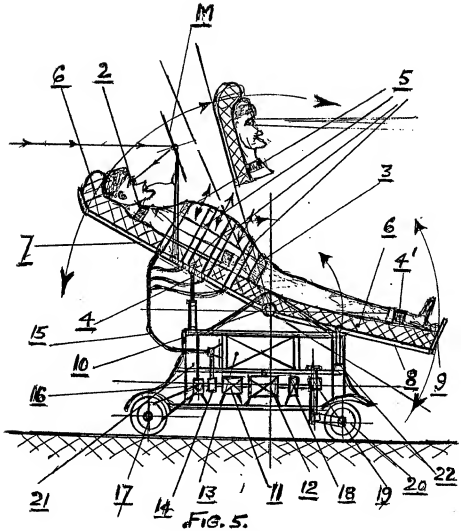


FIG. 5.

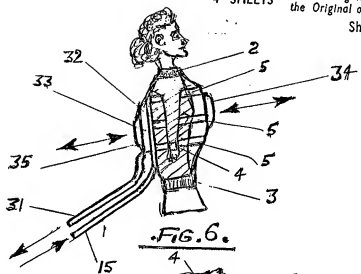


FIG. 6.

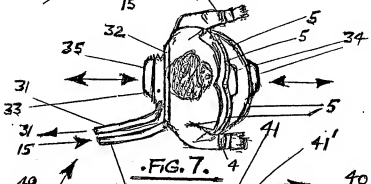


FIG. 7.

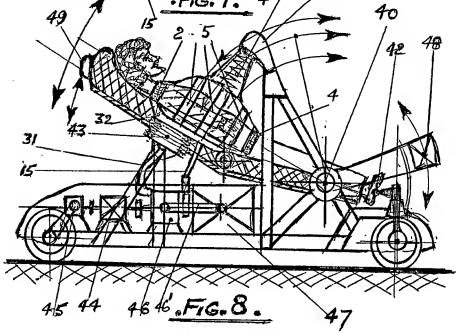


FIG. 8.

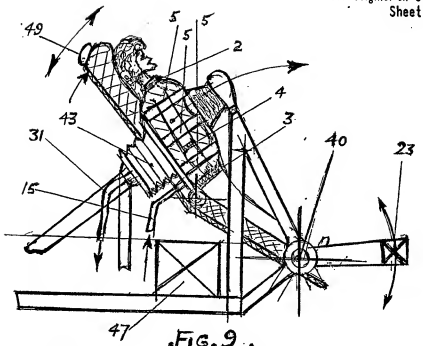


FIG. 9.

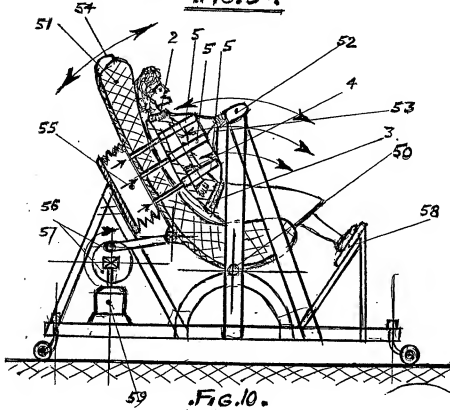


FIG. 10.